

ISLAND BIOGEOGRAPHY AND THE BIRDS OF THE LAKSHADWEEP ARCHIPELAGO, INDIAN OCEAN¹

R.J. RANJIT DANIELS²
(With three text-figures)

The results of a brief survey of the birds on five islands of the Lakshadweep archipelago, Indian ocean, have been discussed. The recent data has been compared with the data published in the past century and earlier this century. These islands are impoverished with regard to their terrestrial habitats and as a result, the number of resident landbirds and inland waterbirds. On the islands surveyed, both in the past and now, 14 species of landbirds and inland waterbirds appear to be residents though direct evidence of breeding is available for only a few of these. The larger islands have a larger number of these resident birds than the smaller. The species-area model predicts between 9 and 20 species of resident landbirds and inland waterbirds on the entire archipelago. The effect of distance from mainland on the avifauna of the island is obscured by the area. Habitat availability seems to have determined the success of colonisation of the islands by birds. A few species of birds have been introduced. However, not all are naturalised.

INTRODUCTION

Oceanic islands are known for their overall impoverishment of biota as compared with similar areas on continents. They are essentially maritime and lack habitat complexity. The relative impoverishment of biota is a result of their origin, size, distance from mainland and also recently, human interference. Due to problems of dispersal, many groups of animals can never reach oceanic islands unaided.

Birds, however, have reached many oceanic islands and colonised them. Oceanic islands have thus a few species of resident landbirds and inland waterbirds, sometimes, none at all. These birds are from the nearest mainland source generally. Families and genera are represented by a few species. The populations are small, especially on small islands. As a result, many island species are extinction-prone.

The other characteristics of island birds is that of being relicts and often endemics. Most oceanic islands have introduced species of landbirds and inland waterbirds today. Some of these are quite naturalised. In what follows, the birds of the Lakshadweep archipelago have been characterised by their status, and possible origin.

The extent to which the present avifauna on these islands has been influenced by size of islands, distance from mainland, habitat availability and human beings has been analysed.

METHODS AND STUDY AREA

Data: A fortnight's cruise aboard the R.V. Gaveshani to the Lakshadweep archipelago, Indian ocean, during April 1988 has provided some data on the birds of the islands. Five inhabited islands (Table 1) were visited and all the birds were recorded going around and across the islands. Each island was thus surveyed for its birds on two consecutive days. Despite the data being small, the islands have been compared between themselves considering their present avifauna and with the published lists of birds from the islands in the past (Hume 1876, Betts 1938, Watson *et al.* 1963, Mathew and Ambedkar 1964).

The islands: The Lakshadweep archipelago is one of the Indian ocean groups of islands lying between 8° to 12°3' N and 71° to 74° E. The shortest distance between the islands and the mainland is at least 250 km. Minicoy, the southernmost island in the archipelago, is separated from the rest by a distance of nearly 200 km. The archipelago, politically under India, has 36 islands — atolls, reefs and emergent banks, which together cover 32 sq. km. Nine of the larger islands and recently one little island, Bangaram (Fig. 1), are inhabited. The population density

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²Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012.

TABLE 1
AREAS, DISTANCES FROM MAINLAND INDIA, HUMAN POPULATION AND NUMBER OF SPECIES OF RESIDENT
LANDBIRDS AND INLAND WATERBIRDS OF FIVE ISLANDS

Island	Area (sq. km)	Distance from mainland (km)*	Human population per sq. km	Number of species of resident land birds and inland waterbirds
Minicoy	4.37	444	1513	6
Kalpeni	2.28	263	1540	4
Kavaratti	3.63	346	1819	5
Kiltan	1.63	252	1484	4
Chetlat	1.03	269	1484	3

*After anonymous (1985).

ranges from 1200-2000 per sq. km. Most islanders are Muslims.

The Lakshadweep archipelago is oceanic, low and flat topographically and coraline. It receives about 150 cm of rainfall annually. Relict patches of low littoral vegetation with *Scaveola* sp. can be scantily seen in the remote parts of the islands (Saldanha 1989). Of the five inhabited

islands visited, only Minicoy had a small tidal swamp with shrubs bordering it at its north-western end. The vegetation on the islands was otherwise dominated by coconut palms dotted with trees and shrubs like *Erythrina indica*, *Azadirachta indica*, *Casuarina* sp., *Callophyllum inophyllum*, *Ficus* sp., *Terminalia catappa*, *Tamarindus indicus*, *Moringa pterygosperma*,

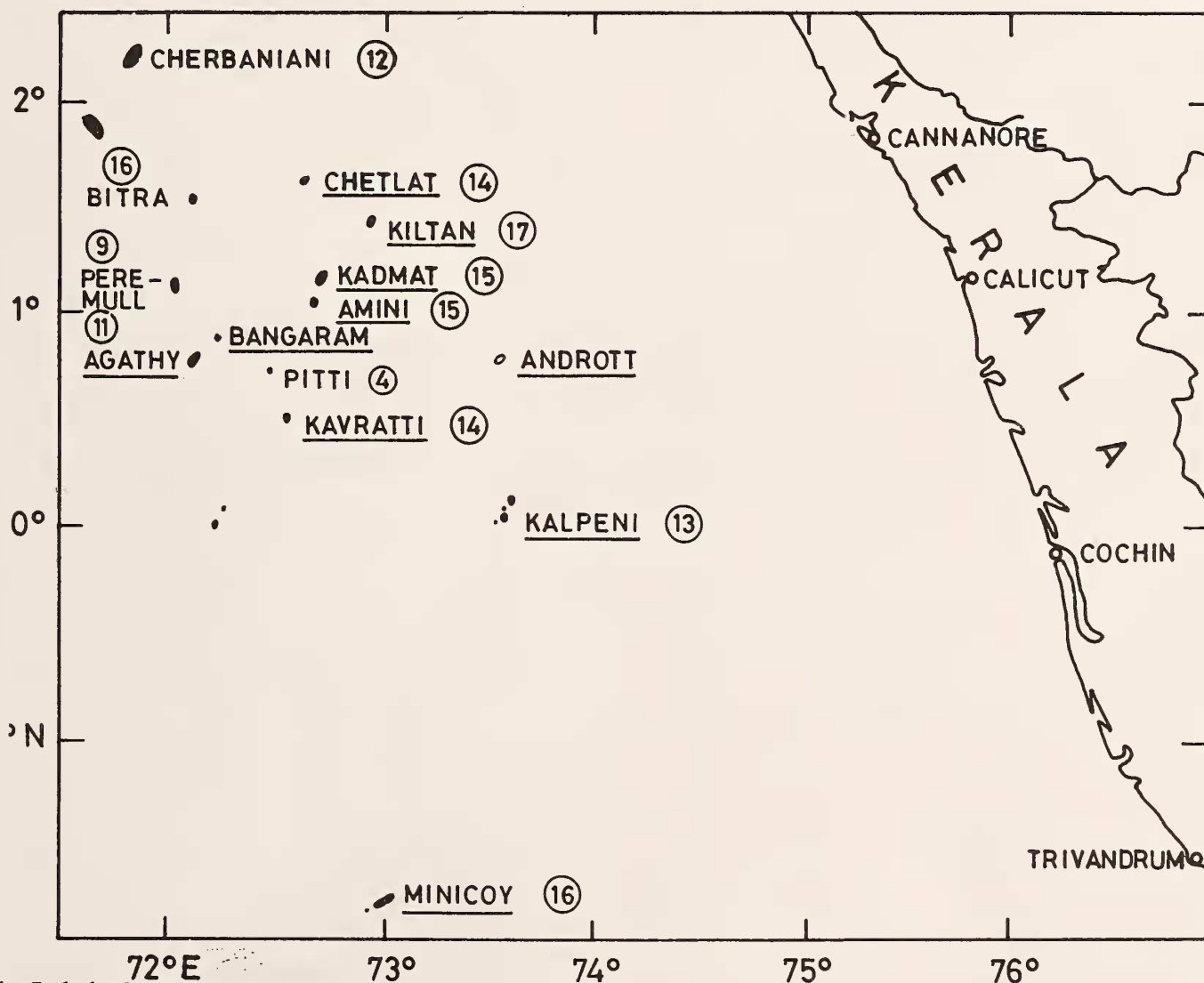


Fig. 1. The Lakshadweep archipelago.

0 20 40 KM

Thespesia sp., *Artocarpus utilis*, *Carica papaya*, *Cerbera* sp., *Ricinus communis*, *Pandanus* sp., and other ornamentals mostly around the settlements. Introduced livestock such as cattle, goats and chicken roam the inhabited islands. Rats were the common rodents. Garden lizards and geckos were the only terrestrial reptiles on the islands. There are dogs, swine and cats on the inhabited islands.

RESULTS AND DISCUSSION

Avifauna: Between 1876 and 1988, the total number of bird species authentically reported from the islands and the adjacent waters is 67. However, only 12 out of the 36 islands have been visited by the different surveyors. Four to 17 species of birds are known from each of these 12 islands (Fig. 1). The surveys were brief, none exceeding a fortnight, and all restricted to the months of February (Hume 1876, Betts 1938), April (this study) and October (Mathew and Ambedkar 1964). Also, since there is not even one set of year round data from the islands, what we have is obviously incomplete.

Landbirds in the families Accipitridae, Falconidae, Pandionidae, Columbidae, Psittacidae, Cuculidae, Strigidae, Alcididae and a few passerines along with inland waterbirds like Ardeidids, Anatids, a Recurvirostrid and a Rallid make up 50% of the 12 islands' hitherto known avifauna. The other 50% consists of migratory waders and the typically oceanic birds like terns, skuas, petrels, boobies, etc. (see Appendix). Of the 34 species of landbirds and inland waterbirds, only 14 are possibly resident in one or more of the islands. The definite evidence of these birds breeding on the islands is however what is known of the blue rock pigeon *Columba livia*, the koel *Eudynamis scolopacea*, the house crow *Corvus splendens* and the white-eye *Zosterops palpebrosa*.

The most significant feature of the Lakshadweep archipelago is the breeding colony of terns in Pitti island and that in Cherbaniani island. Both are uninhabited. Thousands of sooty terns *Sterna fuscata*, large crested terns *Sterna bergii* and

noddy terns *Anous stolidus* are known to breed on these islands (Hume 1876, Mathew and Ambedkar 1964). The Lakshadweep archipelago, besides the three species of terns mentioned above, may have birds like the wedgetailed shearwater *Puffinus lherminieri* and boobies *Sula* spp., breeding off and on (Feare 1984).

Immigration/colonisation and species source: The Lakshadweep archipelago in all probability has three sources from which it has derived its resident landbirds and inland waterbirds, viz. mainland India, Sri Lanka and Maldives. Kerala, the nearest mainland source, has about 300, Sri Lanka about 250 and Maldives, an archipelago of about 2500 islands, seven species and subspecies of resident landbirds and inland waterbirds. The Maldives itself has derived its resident landbirds and inland waterbirds from India and Sri Lanka (Phillips 1963). Minicoy island is closer to the Maldives than it is to mainland India or Sri Lanka. Two out of its six species, viz. the whitebreasted waterhen *Amaurornis phoenicurus* and the little egret *Egretta garzetta* are shared with the Maldivian archipelago and not with any island in the Lakshadweep archipelago. The little egret, however, has been doubtfully recorded as occurring elsewhere on the Lakshadweep archipelago (Mathew and Ambedkar 1964). The white-eye which is spread over most of the other inhabited islands, is absent in Minicoy (Fig. 2). This species has not reached the Maldives either.

The Lakshadweep archipelago has just two species of resident landbirds and inland waterbirds if the MacArthur and Wilson (1967) definition of immigrants is strictly adhered to. The koel and the white-eye are probably the only successful colonists on the islands (Appendix). The small blue kingfisher *Alcedo atthis*, the whitebreasted waterhen, the blackwinged stilt *Himantopus himantopus*, the little green heron *Butorides striatus*, the reef heron *Egretta gularis* and the cattle egret *Bubulcus ibis* are single records from single islands. The grey heron *Ardeola cinerea* and pond heron *Ardeola grayii* and the little egret, though more numerous, have not been reported as breeding on the islands. The only evidence we

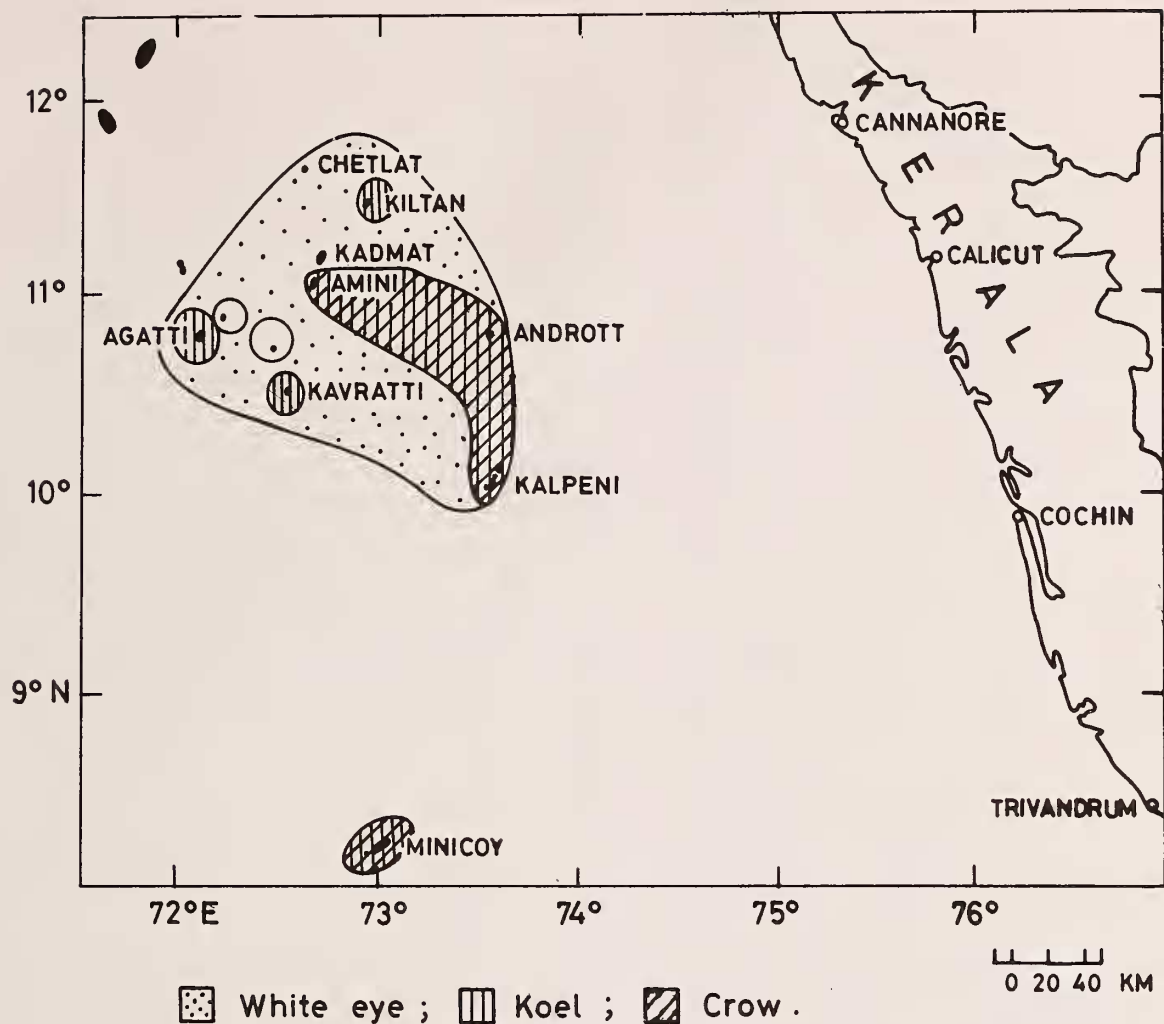


Fig. 2. Occurrence of the white-eye, koel and house crow in different islands of Lakshadweep.

have is the pond heron sighted in breeding plumes in April 1988. This species probably breeds on the islands. The Indian race *grayii* of the pond heron and the little egret have been reported as migrants on the Maldives (Phillips 1963).

Extinction: Whether any species of resident landbird or inland waterbird has gone extinct from the Lakshadweep archipelago or specifically from any of the islands is not evident from the data available. If the archipelago served as 'stepping stones' for these birds to have reached the Maldives, at least a few species would have appeared and disappeared from the islands in the process. These species need not be considered as extinct from the islands in the strict sense (MacArthur and Wilson 1967). Ten islands have been surveyed at least twice in the past 110 years. Three islands, viz. Kiltan, Chetlat and Kavaratti have been surveyed thrice. Only two species, viz. the small blue kingfisher reported from Kavaratti (Mathew and Ambedkar 1964) and the little green heron

reported from Kadmat (Hume 1876) have not been subsequently seen. Both species are known from single records. The kingfisher was not recorded earlier either (Hume 1876). This suggests that these birds were possibly casuals or strays.

If the little green heron, pond heron, white-breasted waterhen and the house crow have reached the Maldives stepping over the Lakshadweep archipelago and in course of time, except the waterhen, evolved into endemic races in the Maldives, it implies that these species have had an 'in-and-out' status on the Lakshadweep archipelago for a fairly long time. That all records of these species of inland waterbirds on the Lakshadweep archipelago between 1876 and 1988 are of birds belonging to the nominate Indian races suggests that individuals or small populations keep arriving on these islands from the mainland.

The race *phoenicurus* of the waterhen found in south India and Sri Lanka, however, also com-

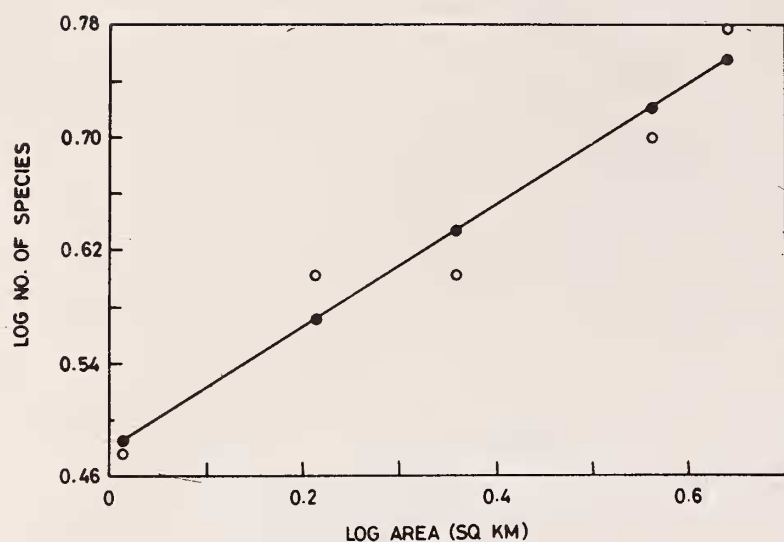


Fig. 3. Relationship between area and number of species of resident landbirds and inland waterbirds on five islands.

monly breeds on many islands in the Maldivian archipelago (Phillips 1963). Considering the weak flight capacity of this species, it seems likely that the bird sighted on Minicoy island in 1988 belonged to a small population resident on the island or already dwindling. The only earlier record of this species from the islands of Lakshadweep is that of Ellis quoted in Betts (1938). As neither the year nor the island where it was sighted has been mentioned, whether the species was found on other islands also and disappeared cannot be said, despite it being a possibility.

Species-area relationship: If the strict definition of an immigrant is for the moment ignored, it appears by the data from the five islands visited in 1988, that the numbers of species of resident landbirds and inland waterbirds on the Lakshadweep archipelago are related to the size of the islands (Table 1). The relationship between log area and log number of species of resident landbirds and inland waterbirds on the five islands visited during this study is shown in Fig. 3. The species-area model, viz.

$$S = c A^z \text{ or } \log S = \log c + z \log A,$$

where S is the number of species, c the constant, A the area of the island and z the slope, was used to fit this line. The values of c , z and r are 3.0, 0.43 ± 0.12 and 0.97 respectively. This observed range of z , 0.31-0.55, is comparatively higher than the general range given, 0.15-0.40 (Williamson 1981). On islands, the z values have

been observed to be steeper than on continents (Preston 1962). Values as high as 0.7 are known. This is also true of small islands and small samples. If therefore the estimated range of z given above for the islands is taken as realistic and the five islands are treated together as a single island of 32 sq. km, there would be 13 species (range 9-20) of resident landbirds and inland waterbirds in the Lakshadweep archipelago. The total number of resident landbirds and inland waterbirds, including those doubtfully resident and introduced, known from the archipelago is 15 (Appendix). Only 10 of these were seen in the recent survey. However, since only five islands have been surveyed, it is not unreasonable to presume that there may be a few more resident landbirds and inland waterbirds on the archipelago. Also, since the surveys were brief, even on the islands visited, a few species could have been overlooked. The individual islands of Lakshadweep, for their size, are certainly impoverished in terms of the number of species of resident landbirds and inland waterbirds. For example, a locality in the mainland of comparable size, viz. the campus of the Indian Institute of Science, Bangalore (1.7 sq. km), has at least 52 species of resident landbirds and inland waterbirds despite being in the heart of a highly urbanised city. There are many available habitats, both natural and man-made. The influence of distance on the birds of these five islands is not clear (Table 1). The farther islands have more resident species than the nearer ones. This possibly is a result of the farther islands also being larger in area.

Influence of habitat: The koel must have colonised the islands only after the arrival of man. The new niches created by man favoured the establishment of the house crow which in turn made the koel a successful colonist on the islands. Koels seem to be good dispersers. Their tendency to wander is reflected by their occasional presence on islands where there are no crows, the host birds for this parasitic cuckoo (Fig. 2). Similarly the presence of the white-eye on all the inhabited islands (except Minicoy island) suggests its

colonisation following man. Its occurrence on Androth island is however not confirmed (Figs. 1, 2). On the mainland, this species occupies a range of habitats from montane evergreen forests to highly urbanised city gardens. The new niche created around human settlements in the form of coconut gardens and mixed orchards of other domestic trees seem to have ensured success of this species on the islands. Species of *Zosterops* are very dispersive and have proved successful in establishing populations in many parts of the world including offshore islands, both aided and unaided by man (Lever 1987).

Lack (1976) suggests that the number of species on an island reflects the climate, habitats, size, etc. The small numbers of resident species of landbirds on islands are due to ecological limitations. The failure of these birds to establish populations comes from a failure to find the right conditions. Small islands are too exposed and less diverse in habitats and hence landbirds often fail to colonise them. Failure of any species to establish itself in an island due to lack of appropriate habitat can be taken as a valid point.

Compared to Lakshadweep, the Maldives have higher rainfall (200-250 cm) and as a result, more luxuriant vegetation, shallow brackish and freshwater pools and marshy areas with extensive reed beds, rank grass and matted *Pandanus* brakes (Phillips 1963). Except probably in Minicoy, generally such habitats are absent in the Lakshadweep archipelago. The only individual of the whitebreasted waterhen on the islands visited in 1988 was observed in the Minicoy swamp. This partly explains the species' absence from the rest of the surveyed islands.

Similarly, the only record of the little green heron is from the Kadmat island, which had, at least at that time, a dense growth of low natural vegetation (Hume 1876). The waterhen, as mentioned earlier, is a well established colonist on the Maldives and the little green heron, besides existing as two resident endemic races on the Maldives, is found as more than 30 different races over the entire tropical and subtropical belts including most of the islands (Howard and Moore

1980).

A classic example of a species extending its geographic range within a short period with the availability of suitable habitat is the cattle egret. Between 1937 and 1954 the species has extended its range from the warmer Eurasia and Africa to South, Central and North America, Bermuda, Australia, New Zealand and New Guinea (Lever 1987). The isolated records of single birds on the Lakshadweep archipelago suggest the failure of this species to colonise the islands. Though there are cattle on the islands, there are no pastures or open ground where they can graze.

Lack of appropriate habitat apparently prevents the colonisation of an otherwise highly dispersive species. Diamond (1971), among other factors responsible for making species of birds unsuccessful or extinction-prone on islands, includes three habitat related factors, viz. narrow habitat requirements, marginal suitability of habitats and small size of available habitats.

Introduction and naturalisation: Introduction is the process of any species or race reaching a territory aided by man, directly or indirectly, where it never existed before. Naturalisation on the other hand is the establishment of self regenerating population (unsupported by and independent of man) of an introduced species or form in a free-living state in the wild (Lever 1987). When rats become a menace on the islands of the Lakshadweep archipelago, the brown wood owl *Strix leptogrammica* was introduced in the latter half of the 19th century. However, these were soon eliminated from the islands by the islanders, basically out of prejudice against a night bird (Hume 1876). This species of owl being a forest bird (Ali and Ripley 1983) could not have anyway naturalized on islands dominated by coconuts with a dearth of natural nest-holes.

Similarly, the Indian myna *Acridotheres tristis* introduced on the islands earlier this century (Ali and Ripley 1983) seems to have failed to naturalise on the islands; the species has not been encountered during recent surveys on any of the inhabited islands. This is surprising, since the species is well established in many parts of the

world, including parts of North America, where it was introduced (Lever 1987). The blue rock pigeon is feral on the islands. Colour variants, certifying domestic ancestry, are more common on the islands. Roseringed parakeets *Psittacula krameri* seen on the islands are probably escapees from cages and that too very recent, since they have not been observed in the 1960s (Mathew and Ambedkar 1964). The species is certainly not naturalised.

If the house crow is an introduced species on the island, it is the only species that has really naturalised on the islands. Where present, it is practically abundant. It is absent on uninhabited islands. Also its pattern of distribution on the islands (Fig. 2) suggests that the bird does not disperse on its own. It is present on Minicoy island. The next population is on Kalpeni, 200 km north of Minicoy. Kalpeni to Androth and Androth to Amini, the distance would be a little over 60 km. The crow is found in all these. Surprisingly it is absent from Kadmat, an island about 10 km from Amini and also visible from it. Betts (1938) records how the crow was once introduced on Kadmat but was soon eliminated by the islanders.

Lack (1976) attributes the failure of the introduced species of birds on the island of Jamaica to unsuitability of habitat and the presence of native competitors. Unsuitability of the habitat could have partly been responsible for the demise of the owl on the islands. Rats, which can destroy the eggs and chicks of hole-nesting birds, probably also played the role of competitors in deterring the success of the owl and myna on the islands where they were introduced. Hume (1876) mentions that when cats were introduced on the islands, the rats "took to the tree-tops." The tree-dwelling rats were there on the islands certainly before the owls and the mynas. Man's role in the success or failure of introduced species of birds such as the crow (on at least one island) and the owl on these islands is quite evident.

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APPENDIX
A LIST OF BIRDS KNOWN FROM THE LAKSHADWEEP ARCHIPELAGO AND THE ADJACENT WATERS

Sl. No.	Name of species	Status
Procellariidae		
1.	Wedge tailed shearwater <i>Procellaria pacifica</i>	U*
2.	Persian shearwater <i>Procellaria lherminieri</i>	U*
3.	Jouanin's gadfly petrel <i>Bulweria fallax</i>	U*
4.	Wilson's storm petrel <i>Oceanites oceanicus</i>	U*
5.	Forktailed storm petrel <i>Oceanodroma leucorhoa</i>	U*
Phaethontidae		
6.	Short-tailed tropic-bird <i>Phaethon aethereus</i>	U*
Sulidae		
7.	Masked booby <i>Sula dactylatra</i>	R
8.	Redfooted booby <i>Sula sula</i>	R
9.	Brown booby <i>Sula leucogaster</i>	R
Ardeidae		
10.	Eastern grey heron <i>Ardea cinerea</i>	R?
11.	Little green heron <i>Butorides striatus</i>	R?
12.	Indian pond heron <i>Ardeola grayii</i>	R?
13.	Cattle egret <i>Bubulcus ibis</i>	R?
14.	Little egret <i>Egretta garzetta</i>	R?
15.	Indian reef heron <i>Egretta gularis</i>	R?
Anatidae		
16.	Common teal <i>Anas crecca</i>	M
17.	Garganey <i>Anas querquedula</i>	M
18.	White-eyed pochard <i>Aythya nyroca</i>	M
Accipitridae		
19.	Blackwinged kite <i>Elanus caeruleus</i>	M
20.	Pariah kite <i>Milvus migrans</i>	S
21.	White-bellied sea eagle <i>Haliaeetus leucogaster</i>	S
22.	Pale harrier <i>Circus macrourus</i>	M
23.	Montagu's harrier <i>Circus pygargus</i>	M
24.	Marsh harrier <i>Circus aeruginosus</i>	M
Pandionidae		
25.	Osprey <i>Pandion haliaetus</i>	M
Falconidae		
26.	Peregrine falcon <i>Falco peregrinus</i>	M
27.	Kestrel <i>Falco tinnunculus</i>	M
Rallidae		
28.	Whitebreasted waterhen <i>Amaurornis phoenicurus</i>	R?
Charadriidae		
29.	Grey plover <i>Pluvialis squatarola</i>	M
30.	Golden plover <i>Pluvialis dominica</i>	M
31.	Large sand plover <i>Charadrius leschenaultii</i>	M
32.	Kentish plover <i>Charadrius alexandrinus</i>	M
33.	Lesser sand plover <i>Charadrius mongolus</i>	M
34.	Whimbrel <i>Numenius phaeopus</i>	M
35.	Curlew <i>Numenius arquata</i>	M
36.	Greenshank <i>Tringa nebularia</i>	M
37.	Common sandpiper <i>Tringa hypoleucos</i>	M
38.	Turnstone <i>Arenaria interpres</i>	M

Sl. No.	Name of species	Status
39.	Eastern knot <i>Calidris tenuirostris</i>	M
40.	Sanderling <i>Calidris albus</i>	M
41.	Little stint <i>Calidris minuta</i>	M
Recurvirostridae		
42.	Blackwinged stilt <i>Himantopus himantopus</i>	R?
Dromadidae		
43.	Crab plover <i>Dromas ardeola</i>	U
Stercorariidae		
44.	South polar skua <i>Catharacta maccormicki</i>	M*
45.	Pomatorhine skua <i>Stercorarius pomarinus</i>	M*
46.	Parasitic skua <i>Stercorarius parasiticus</i>	M*
Laridae		
47.	Whitecheeked tern <i>Sterna repressa</i>	M
48.	Brownwinged tern <i>Sterna anaethetus</i>	R
49.	Sooty tern <i>Sterna fuscata</i>	R
50.	Little tern <i>Sterna albifrons</i>	U
51.	Large crested tern <i>Sterna bergii</i>	R
52.	Lesser crested tern <i>Sterna bengalensis</i>	R
53.	Noddy tern <i>Anous stolidus</i>	R
Columbidae		
54.	Blue rock pigeon <i>Columba livia</i>	IR
55.	Rufous turtle dove <i>Streptopelia orientalis</i>	S
Psittacidae		
56.	Roseringed parakeet <i>Psittacula krameri</i>	IR?
Cuculidae		
57.	Koel <i>Eudynamys scolopacea</i>	R
Strigidae		
58.	Brown wood owl <i>Strix leptogrammica</i>	IE
Alcididae		
59.	Small blue kingfisher <i>Alcedo atthis</i>	R?
Hirundinidae		
60.	Eastern swallow <i>Hirundo rustica</i>	M
61.	House martin <i>Delichon urbica</i>	M
Lanidae		
62.	Brown shrike <i>Lanius cristatus</i>	M
Corvidae		
63.	House crow <i>Corvus splendens</i>	IR
Sturnidae		
64.	Indian myna <i>Acridotheres tristis</i>	IE
Motacillidae		
65.	Pipit <i>Anthus</i> sp.	U
66.	Yellow wagtail <i>Motacilla flava</i>	M
Zosteropidae		
67.	White-eye <i>Zosterops palpebrosa</i>	R

R: residents; M : migrant; U : uncertain; S : stragglers; I : introduced; E: extinct. Asterix marks those seen only on the ocean. Birds with *italic* serial numbers are those seen by the author in 1988.